Product Selector Guide

Casting and impregnation systems

ARALDITE®, ARADUR®, ARATHANE®

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Casting and impregnation systems

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Innovative insulation systems backed by more than 50 years of experience

			Indoor Systems		
Applications			①	①	③
System	resin hardener accelerator filler		**ARALDITE® CY 5538** **ARADUR® HY 5571-1** **Silica or ATH**	**ARALDITE® CY 5936** **ARADUR® HY 5945** **Silica**	**ARALDITE® CY 5948** **ARADUR® HY 5934** **Silica**
Supplied			unfilled	unfilled	unfilled
Density of casting		g / cm³	1.88	1.85	1.85
Mixing ratio: resin/hardener/accelerator/filler		parts by weight	100 / 100 / – /390	100 / 80 / – / 350	100 / 80 / – / 350
Viscosity	resin hardener mixture	mPas /°C	4'800 / 25 520 / 25 6'000 / 60	2'000 / 25 350 / 25 10'000 / 60	2'500 / 25 300 / 25 15'000 / 60
Pot life (viscosity increase up to 15'000 mPas)		h / °C	6 / 60	9.5 / 60	3 / 70 2 / 80
Gel time		min / °C	350 / 80 29 / 120 9.5 / 140	800 / 80 290 / 100 100 / 120	300 / 80 15 / 120 4 / 140
Typical curing time		h / °C	8 / 80 + 10 / 130	6 / 80 + 10 / 140	4 / 80 + 10 / 140
Preferred processing			Vacuum Casting	Vacuum Casting	APG, Vacuum Casting
Glass transition temperature		°C	55	70	80
Thermal conductivity	25°C	W / mK	1.00	1.00	1.05
Thermal class			F	F	F
Tensile strength	23°C	MPa	70	80	82
Flexural strength	23°C	MPa	120	135	140
Elongation at break	23°C	%	1.5	1.3	1.1
Fracture toughness	K_{1c} G_{1c}	$MPa\sqrt{m}$ J / m²	3.0 670	3.2 850	2.8 600
Modulus of elasticity	23°C	MPa	10'500	12'000	11'500
Comparative tracking index			> 600 – 0.0	> 600 – 0.0	> 600 – 0.0
Dielectric dissipation factor tan δ	50 Hz / 23°C	%	2.4	2.8	2.2
Relative permittivity ϵ_r	50 Hz / 23°C		4.4	4.8	4.5
Dielectric strength (2 mm plate)	23°C	kV / mm	21 (3 mm)	24	21

① Dry-type distribution transformers ② Generators and motors: large rotating machines ③ Instrument transformers ④ Insulators

This product selector guide provides an overview on our key products for impregnation and casting systems, such as dry type distribution transformers, generators and motors, instrument transformers, insulators and bushings as well as switchgears. Additional systems are also available. Our sales engineers will help you to find the ideal system for your application and process.

⑤a ⑤b	④ ⑤a ⑤b	④	⑤b	②c	③
RESIN XB 5992 **HARDENER XB 5993** **Silica**	**ARALDITE® CY 228-1** **ARADUR® HY 918** **DY 062** **Silica**	**ARALDITE® CY 225** **ARADUR® HY 925** **Silica**	**ARALDITE® CY 5995** **ARADUR® HY 5996** **Silica**	**ARALDITE® MY 790-1** **ARADUR® HY 1102** **DY 9577 or DY 073-1**	**RESIN XB 5938-1** **HARDENER XB 5939-1**
unfilled	unfilled	unfilled	unfilled	unfilled	prefilled
1.90	1.82	1.78	1.76	1.20	1.90
100 / 90 / – / 350	100 / 85 /0.8 / 345	100 / 80 / – / 270	100 / 87 / – / 280	100 / 90 / 0.16 or 0.04	100 / 100
4'300 / 25 65 / 25 6'000 / 60	4'300 / 25 65 / 25 5'500 / 60	12'000 / 25 350 / 25 7'000 / 60	55'000 / 25 180 / 25 4'500 / 60	5'200 / 25 70 / 25 130 / 40	17'000 / 40 21'000 / 40 7'000 / 60
2 / 60 0.7 / 80	2.5 / 60	6 / 60 3 / 80	6 / 60 3.3 / 80	4'000 / 25* 400 / 40*	4 / 60 1.8 / 80
95 / 80 9 / 120 3.5 / 140	120 / 80 12 / 120 5 / 140	300 / 80 13 / 120 5 / 140	200 / 80 18 / 120 6 / 140	360 / 100 80 / 120 22 / 140	210 / 80 21 / 120 7 / 140
0.5 / 140	10 / 140	6 / 80 + 10 / 130	2 / 100 + 16 / 140	24 / 80 + 10 / 140	10 / 80 + 10 / 140
APG	APG	APG	Vacuum Casting	VPI	APG, Vacuum Casting
108	114	115	140	140	87
0.95	1.00	0.85	0.78	0.15	1.00
H	H	200	F	H	F
73	85	75	75	60	74
118	130	120	120	128	120
0.9	0.9	1.2	1.3	5.0	1.1
2.1 360	2.2 370	1.9 320	2.0 460	0.6 90	2.5 460
10'800	12'500	10'500	9'000	3'200	11'300
> 600 < 1.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.2	> 600 – 0.0
3	3.5	1.9	3.3	0.3	1.5
4.2	4.2	4.2	4.1	3.2	4.0
22	20	19 (3 mm)	22	27	22

and bushings ⑤ Switchgears a) medium voltage b) high voltage * Time to double viscosity

Please note that the values given in this selector guide are typical values determined by testing standard test specimens. They are not directly indicative of the in-service performance of a casting. Therefore, before initiating a production run, manufacturers are advised to carry out their own preliminary tests using preproduction models.

Outdoor Systems

① ② ③ ④ ⑤a ⑤b	④ ⑤b	③ ④ ⑤a ⑤b	③ ④ ⑤a ⑤b	④ ⑤a ⑤b
ARALDITE® CW 229-3 ARADUR® HY 229-1	**RESIN XB 5915 HARDENER XB 5916**	**ARALDITE® CY 184 ARADUR® HY 1235 DY 062 Silane treated silica**	**ARALDITE® CY 5622 ARADUR® HY 1235 DY 062 Silane treated silica**	**RESIN XB 5918-3 HARDENER XB 5919-3**
prefilled	prefilled	unfilled	unfilled	prefilled
1.85	1.65	1.65	1.87	1.80
100 / 100	70 / 100	100 / 90 / 0.6 / 370	100 / 82 / 0.45 / 355	100 / 100
120'000 / 25 12'000 / 25 2'000 / 60	20'000 / 40 15'000 / 40 7'500 / 60	900 / 25 75 / 25 10'000 / 60	4'000 / 25 75 / 25 8'000 / 60	13'000/ 40 4'000 / 40 3'500 / 60
8 / 60 2.5 / 80	7 / 60 2.5 / 80	3 / 60 1.0 / 80	3 / 60 1.5 / 80	5 / 60 1.5 / 80
300 / 80 18 / 120 6 / 140	180 / 80 20 / 120 7 / 140	100 / 80 3 / 120 2 / 140	90 / 80 10 / 120 4 / 140	150 / 80 11 / 120 6 / 140
10 / 80 + 10 / 140	2 / 100 + 10 / 140 + 2 / 160	2 / 100 + 16 / 140	10 / 140	2 / 100 + 16 / 140
APG	APG	APG	APG	APG
115	140	110	110	108
0.70	0.65	1.05	1.00	0.85
200	F	F	F	F
85	75	95	92	88
125	115	155	140	160
1.4	1.2	1.4	1.4	1.9
2.9 710	2.7 760	2.6 500	2.5 510	2.7 630
10'500	8'900	12'800	11'500	10'000
> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0
1.2	0.8	1.2	1.5	1.5
4.3	4.2	4.0	4.0	4.0
20	20	19 (3 mm)	23	20 (3 mm)


①


②


③


④


⑤

Definitions of properties

Properties	Standards	Definitions
Density	ISO 1183	Weight of a volume [V], $\rho = m / V$
Viscosity	ISO 2555	Measure of the resistance to flow of a fluid under an applied force
Gel time	ISO 9396	Time taken for a material to solidify or become extremely viscous
Glass transition temperature	ISO 11357-2	Approximate midpoint of the temperature range over which a material undergoes a phase change from a hard, glass-like state to a rubbery state or vice versa
Thermal conductivity	ISO 8894-2	Heat flow per unit area divided by the temperature gradient [W/mK]
Temperature index	IEC 60216	The temperature index (TI) is a measurement for the thermal stability. It provides the basis for classifying an insulating material into a thermal class. The TI allows different insulation materials to be compared, but only if the same end point criterion is applied (e.g. weight loss 10%, flexural strength 50%). The higher the TI, the better is the thermal behavior of the material.
Thermal class	IEC 60085	Thermal classes Y = 90°C, A = 105°C, E = 120°C, B = 130°C, F = 155°C, H = 180°C, 200 = 200°C, 220 = 220°C
Shore hardness	DIN 53805	Resistance against the penetration of a body of specified shape, applied under a specified spring load
Tensile strength	ISO 527	Maximum tensile stress sustained by a material during a tensile test (stretching)
Flexural strength	ISO 178	Maximum flexural stress sustained by a material during a bending test
Elongation at break	ISO 527	Tensile strain at which the material breaks
Modulus of elasticity	ISO 527	Stress [σ] required to produce unit strain [ϵ], E = [σ/ϵ] (Young's Modulus)
Fracture toughness (K_{1c} G_{1c})	internal test PM 216-0 double-torsion test (for prefilled material) ISO 13586 bend notch test (for unfilled material)	The double-torsion test and the bend notch test are controlled crack propagation methods for measuring the energy required to propagate a crack. - K_{1c}, critical stress intensity factor: K_I defines the stress field around the sharp crack; the fracture occurs when K_I reaches the critical value K_{1c}. - G_{1c}, specific energy of fracture: measure of resistance to crack propagation in a material under static load. The higher the values of K_{1c} and G_{1c}, the tougher is the material.
Comparative tracking index CTI	IEC 60112	The comparative tracking index is the numerical value of the maximum voltage at which five test specimens withstand the test period for 50 drops without tracking failure and without a persistent flame occurring and including also statements relating to the behavior of the material when tested using 100 drops and the depth of erosion.
Dielectric dissipation factor tan δ	IEC 60250	The dielectric dissipation factor tan δ of a material indicates the electrical losses of the dielectric. It is the tangent of the dielectric loss angle δ. The dielectric loss angle δ of an insulating material is the angle by which the phase difference between applied voltage and resulting current deviates from 90 degrees, when the dielectric of the capacitor consists exclusively of the dielectric material.
Relative permittivity ϵ_r	IEC 60250	The relative permittvity ϵ_r of an insulating material is the ratio of capacitance of a capacitor, in which the space between and around the electrodes is entirely and exclusively filled with the insulating material in question, to the capaci-tance of the same configuration of electrodes in vacuum. The permittivity ϵ of an insulating material is the product of its relative permittivity ϵ_r and the electric constant (or permittivity of vacuum) ϵ_o.
Dielectric strength	IEC 60243-1 IEC60455-2 (1998)	The dielectric strength is the quotient of the breakdown voltage and the distance between the conducting parts between which the voltage is applied under prescribed test conditions.

Values for thermal conductivity of cured systems	**[W/mK]**
Unfilled systems	0.1 – 0.2
Silica-filled systems	0.8 – 1.0
Wollastonite-filled systems	0.6 – 0.8

Typical post curing conditions (minimum post curing for liquid systems)

Automatic Pressure Gelation Process (APG):	7 h at 130°C or 5 h at 140°C
Vacuum Casting Process:	14 h at 130°C or 10 h at 140°C
Vacuum Pressure Impregnation (VPI):	24 h at 80°C + 10 h at 140°C

Remarks

Tests on ARALDITE® insulation systems filled with silica have been carried out with with a conventional silica powder.
For any further information required on the listed systems, please refer to our technical data sheets.

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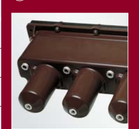
		Indoor Systems									Outdoor Systems				
Applications		①	①	③	⑤a ⑤b	④ ⑤a ⑤b	④	⑤b	2c	③	① ② ③ ④ ⑤a ⑤b	④ ⑤b	③ ④ ⑤a ⑤b	③ ④ ⑤a ⑤b	④ ⑤a ⑤b
System resin / hardener / accelerator / filler		**ARALDITE® CY 5538 ARADUR® HY 5571-1 Silica or ATH**	**ARALDITE® CY 5936 ARADUR® HY 5945 Silica**	**ARALDITE® CY 5948 ARADUR® HY 5934 Silica**	**RESIN XB 5992 HARDENER XB 5993 Silica**	**ARALDITE® CY 228-1 ARADUR® HY 918 DY 062 Silica**	**ARALDITE® CY 225 ARADUR® HY 925 Silica**	**ARALDITE® CY 5995 ARADUR® HY 5996 Silica**	**ARALDITE® MY 790-1 ARADUR® HY 1102 DY 9577 or DY 073-1**	**RESIN XB 5938-1 HARDENER XB 5939-1**	**ARALDITE® CW 229-3 ARADUR® HY 229-1**	**RESIN XB 5915 HARDENER XB 5916**	**ARALDITE® CY 184 ARADUR® HY 1235 DY 062 Silane treated silica**	**ARALDITE® CY 5622 ARADUR® HY 1235 DY 062 Silane treated silica**	**RESIN XB 5918-3 HARDENER XB 5919-3**
Supplied		unfilled	unfilled	unfilled	unfilled	unfilled	unfilled	unfilled	unfilled	prefilled	prefilled	prefilled	unfilled	unfilled	prefilled
Density of casting	g / cm³	1.88	1.85	1.85	1.90	1.82	1.78	1.76	1.20	1.90	1.85	1.65	1.65	1.87	1.80
Mixing ratio: resin/hardener/accelerator/filler	parts by weight	100 / 100 / – /390	100 / 80 / – / 350	100 / 80 / – / 350	100 / 90 / – / 350	100 / 85 /0.8 / 345	100 / 80 / – / 270	100 / 87 / – / 280	100 /90 /0.16 or 0.04	100 / 100	100 / 100	70 / 100	100 / 90 / 0.6 / 370	100 / 82 / 0.45 / 355	100 / 100
Viscosity resin	mPas /°C	4'800 / 25	2'000 / 25	2'500 / 25	4'300 / 25	4'300 / 25	12'000 / 25	55'000 / 25	5'200 / 25	17'000 / 40	120'000 / 25	20'000 / 40	900 / 25	4'000 / 25	13'000/ 40
Viscosity hardener	mPas /°C	520 / 25	350 / 25	300 / 25	65 / 25	65 / 25	350 / 25	180 / 25	70 / 25	21'000 / 40	12'000 / 25	15'000 / 40	75 / 25	75 / 25	4'000 / 40
Viscosity mixture	mPas /°C	6'000 / 60	10'000 / 60	15'000 / 60	6'000 / 60	5'500 / 60	7'000 / 60	4'500 / 60	130 / 40	7'000 / 60	2'000 / 60	7'500 / 60	10'000 / 60	8'000 / 60	3'500 / 60
Pot life (viscosity increase up to 15'000 mPas)	h / °C	6 / 60	9.5 / 60	3 / 70 2 / 80	2 / 60 0.7 / 80	2.5 / 60	6 / 60 3 / 80	6 / 60 3.3 / 80	4'000 / 25* 400 / 40*	4 / 60 1.8 / 80	8 / 60 2.5 / 80	7 / 60 2.5 / 80	3 / 60 1.0 / 80	3 / 60 1.5 / 80	5 / 60 1.5 / 80
Gel time	min / °C	350 / 80 29 / 120 9.5 / 140	800 / 80 290 / 100 100 / 120	300 / 80 15 / 120 4 / 140	95 / 80 9 / 120 3.5 / 140	120 / 80 12 / 120 5 / 140	300 / 80 13 / 120 5 / 140	200 / 80 18 / 120 6 / 140	360 / 100 80 / 120 22 / 140	210 / 80 21 / 120 7 / 140	300 / 80 18 / 120 6 / 140	180 / 80 20 / 120 7 / 140	100 / 80 3 / 120 2 / 140	90 / 80 10 / 120 4 / 140	150 / 80 11 / 120 6 / 140
Typical curing time	h / °C	8 / 80 + 10 / 130	6 / 80 + 10 / 140	4 / 80 + 10 / 140	0.5 / 140	10 / 140	6 / 80 + 10 / 130	2 / 100 + 16 / 140	24 / 80 + 10 / 140	10 / 80 + 10 / 140	10 / 80 + 10 / 140	2 / 100 + 10 / 140 + 2 / 160	2 / 100 + 16 / 140	10 / 140	2 / 100 + 16 / 140
Preferred processing		Vacuum Casting	Vacuum Casting	APG, Vacuum Casting	APG	APG	APG	Vacuum Casting	VPI	APG, Vacuum Casting	APG	APG	APG	APG	APG
Glass transition temperature	°C	55	70	80	108	114	115	140	140	87	115	140	110	110	108
Thermal conductivity 25°C	W / mK	1.00	1.00	1.05	0.95	1.00	0.85	0.78	0.15	1.00	0.70	0.65	1.05	1.00	0.85
Thermal class		F	F	F	H	H	200	F	H	F	200	F	F	F	F
Tensile strength 23°C	MPa	70	80	82	73	85	75	75	60	74	85	75	95	92	88
Flexural strength 23°C	MPa	120	135	140	118	130	120	120	128	120	125	115	155	140	160
Elongation at break 23°C	%	1.5	1.3	1.1	0.9	0.9	1.2	1.3	5.0	1.1	1.4	1.2	1.4	1.4	1.9
Fracture toughness 23°C	K_{Ic} MPa$\sqrt{m}$	3.0	3.2	2.8	2.1	2.2	1.9	2.0	0.6	2.5	2.9	2.7	2.6	2.5	2.7
	G_{Ic} J / m²	670	850	600	360	370	320	460	90	460	710	760	500	510	630
Modulus of elasticity 23°C	MPa	10'500	12'000	11'500	10'800	12'500	10'500	9'000	3'200	11'300	10'500	8'900	12'800	11'500	10'000
Comparative tracking index		> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 < 1.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.2	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0	> 600 – 0.0
Dielectric dissipation factor tan δ 50 Hz / 23°C	%	2.4	2.8	2.2	3	3.5	1.9	3.3	0.3	1.5	1.2	0.8	1.2	1.5	1.5
Relative permittivity ϵ_r 50 Hz / 23°C		4.4	4.8	4.5	4.2	4.2	4.2	4.1	3.2	4.0	4.3	4.2	4.0	4.0	4.0
Dielectric strength (2 mm plate) 23°C	kV / mm	21 (3 mm)	24	21	22	20	19 (3 mm)	22	27	22	20	20	19 (3 mm)	23	20 (3 mm)


① Dry-type distribution transformers


② Generators and motors: large rotating machines


③ Instrument transformers


④ Insulators and bushings


⑤ Switchgears a) medium voltage b) high voltage

* Time to double viscosity